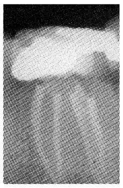

CASE REPORT

# Periosteal grafts as barriers in periradicular surgery: report of two cases

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**Abstract**

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**Aim** To describe the usefulness of periosteal grafts as barriers for bone regeneration in periradicular surgery when advanced periodontal breakdown occurs.
**Summary** The treatment of advanced periodontal breakdown as a result of an associated endodontic lesion constitutes a multifaceted challenge to the clinician. If the source of the irritation cannot be removed by orthograde endodontic treatment, nonsurgical and surgical endodontic/periodontal intervention may be required. Two cases with suppurative chronic apical periodontitis with apicomarginal communication are described. Clinical and radiological evaluations were completed immediately prior to surgery, a week later and every 2 months after surgery for 10 months. Both patients were treated using split-thickness flaps and lateral displacement of the periosteum prior to suturing, in order to close the communication between the oral and the periapical surroundings. A remission of the clinical signs and symptoms, and successful healing in the short-term were achieved in these cases.
**Key learning points**
- Periapical and periodontal lesions are closely related through pathways of communication.
- Disruption of the cortical plate and the presence of dentoalveolar sinus tracts can have a deleterious effect on the regeneration process after periradicular surgery.
- The adoption of supplementary periodontal surgical techniques may help to solve some of the difficulties in the healing process in periradicular surgery.
- Periosteal grafts have been shown to have the potential to stimulate bone formation when used as a graft material.

**Keywords:** apicomarginal communication, guided bone regeneration, membranes, periosteum, periradicular surgery, sinus tract.

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## Introduction

Assessment of success or failure after periradicular surgery is based on clinical and radiographic criteria. Generally, the prognosis of periradicular surgery varies between 25 and 90% (Gutmann & Harrison 1991). This wide variation is a reflection of the multiplicity of factors that affect the outcome, including the size of the lesion, periodontal involvement, perforation of the cortical plate, and persistent sinus tracts. When bony destruction of the pathological process includes the cortical plate, the prognosis for success is reported to be 37% (Skoglund & Persson 1985).

There is a close ontogenetic inter-relationship between periodontal and pulpal tissues. Clinically, this relationship promotes the spread of infection, potentially resulting in typical manifestations of endo-perio osseous lesions (Bergenholtz & Hasselgren 1997). Different hypotheses have been proposed to explain these clinically verified relationships. The apical foramen is the main pathway between these two tissues. However, in a number of cases accessory canals are present either to the lateral aspect or, in multi-rooted teeth, to the furcational aspect of the roots. A third pathway of communication can include the dentinal tubules. Normally covered by a protective cementum barrier, the tubules become patent following damage to the cementum after trauma or following cementum removal during root scaling and planing (Ehnevid *et al.* 1993, Jansson *et al.* 1993). In addition, a communication may arise following accidental perforation of the root canal or because of pathological internal/external root resorption (Von Arx & Cochran 2001).

Apicomarginal lesions that are primarily endodontic in origin characteristically expand to the periodontal structures through these pathways, resulting in an osseous defect that progresses relatively rapidly along the periodontal ligament from apical to coronal. Alternatively, a sinus tract forms (Haueisen & Heidemann 2002) as a route of drainage from periapical inflammatory lesions that follows the path of least resistance through bone, periosteum and mucosa (Baumgartner *et al.* 1984). The probing depths of the tooth remain normal until advanced periodontal breakdown occurs and a closely circumscribed lesion reveals significant probing depths of 10–12 mm.

According to Von Arx & Cochran (2001), typical periradicular lesions are distinguished by their location, extension, or pathway of infection as *Class Ia lesion* (bone defect confined to periapical region), *Class Ib lesion* (periapical bone defect with erosion of buccal and/or lingual cortical plate), *Class IIa lesion* (periapical and concomitant marginal lesion without communication), *Class IIb lesion* (periapical and concomitant marginal lesion with communication), *Class IIIa lesion* (lateral juxtaradicular lesion), and *Class IIIb lesion* (lateral juxtaradicular lesion with communication to marginal lesion).

Both presence of a dentoalveolar sinus tract (class Ib lesion) and apicomarginal communication (class IIb lesion) may allow epithelial migration and proliferation of gingival connective tissue from the adjacent oral mucosa into periapical defects and prevent healing and the formation of normal trabecular bone (Dahlin *et al.* 1988). In addition, the epithelialized tract may permit further contamination through ingress of bacteria and bacterial byproducts from the oral cavity (Skoglund & Persson 1985, Perlmutter *et al.* 1988, Abramowitz *et al.* 1994). As the periosteum is damaged in such cases, this enhances the chance of unreliable repair (Pecora *et al.* 2001).

Several studies in humans and animals have evaluated the concept of guided tissue regeneration (GTR) and guided bone regeneration (GBR). This has led to the development of synthetic bone substitutes, bone grafts and membranes or barriers that allow the cellular regrowth of periodontal defects caused by pathosis or surgical trauma (Wang & MacNeil 1998). Likewise, different studies have demonstrated that this technique can also be successfully applied in endodontic surgery (Abramowitz *et al.* 1994, Pecora *et al.* 1995, 2001, Rankow & Krasner 1996, Uchin 1996, Tobón *et al.* 2002, Dietrich *et al.* 2003).

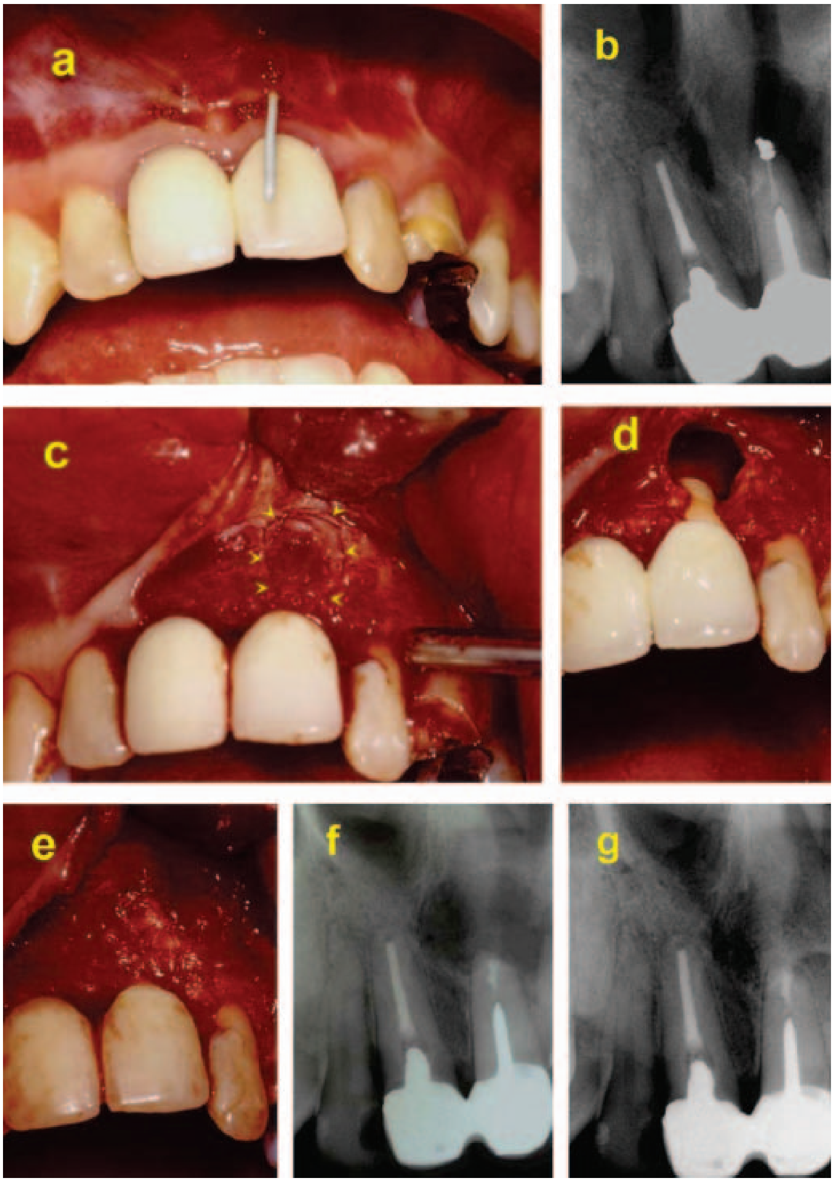


**Figure 1** Surgical procedure to correct a class IIb defect of the maxillary left central incisor with chronic suppurative apical periodontitis. (a) Clinical appearance of the tooth and its surrounding mucosa. A sinus tract opening is observed. (b) Preoperative radiograph of periapical lesion. (c) Split-thickness flap reflected under gentle tension and periosteal incisions to remove the pathological tissue (arrowheads). (d) Surgical exposure of the bone defect and resected root-end before periosteal graft has been raised. (e) The periosteal graft is placed over the entire defect after silver alloy amalgam was removed and root-end filled with IRM. (f) Immediate postoperative radiographical appearance. (g) Radiographical appearance 10 months after periradicular surgery. The case was classified as successful.

The ideal barrier material should be biocompatible; easy to obtain, harvest, and manipulate; abundant; bioabsorbable and economical (Laurell & Gottlow 1998). As a structure rich in osteoprogenitor cells, the periosteum has been viewed as having regenerative potential (Ishida *et al.* 1996, Ueno *et al.* 1999, 2001). Autogenous periosteal grafts are an attractive alternative to existing barrier membrane materials since they meet the requirements of an ideal material and they are biologically accepted. Moreover, periosteum has the potential to stimulate osteogenesis in the bony defect area (Goldman & Smukler 1978, Lekovic *et al.* 1991, Kwan *et al.* 1998).

The purpose of this work was to describe the use of periosteal grafts as barrier membranes in GBR in combined periapical–periodontal (class IIb) defects.



## Reports

### Case 1

A 45-year-old female was referred for periradicular surgery for a draining sinus tract in the vestibular mucosa on the maxillary left central incisor (tooth 21). She had a noncontributory medical history. No history of trauma to the area was elicited. Ten years previously, root canal treatment had been carried out; however, continuous discomfort had resulted in periradicular surgery procedure being carried out on tooth 21. The sinus tract appeared shortly after completion of this treatment. The patient's complaint was of periodic discharge of pus from the sinus tract, mild sensitivity on percussion and tooth mobility. Two ferruled porcelain fused to metal crowns were present on teeth 11 and 21 (Fig. 1a). A gutta-percha cone placed into the sinus tract appeared to extend to the apex of tooth 21. Probing the area yielded an 8–10 mm pocket depth at different points on the buccal surface, giving a definite clinical impression of apicomarginal involvement. Radiographical examination revealed a periapical radiolucency at the apex of tooth 21, a post and crown with root canal filling and an amalgam apical root-end filling (Fig. 1b). Crown margins appeared intact clinically and radiographically. A pretreatment diagnosis of chronic suppurative apical periodontitis with apicomarginal communication (class IIb lesion) was made. Informed consent from the patient was obtained after the nature of the surgical procedure and possible discomforts and risks were fully explained.

### Case 2

A 38-year-old female was referred for periradicular surgery on the maxillary left central incisor (tooth 21). She had a noncontributory medical history. Clinically all teeth were non carious or adequately restored. The patient stated that she was 25 years old when dental trauma had occurred on this tooth. The patient's history did not reveal whether the tooth was luxated, intruded or extruded. Previous dental history included nonsurgical root canal treatment performed 12 years earlier. The patient complained of periodic discharge of pus from the periodontal pocket and sinus tract, sensitivity on percussion, grade II tooth mobility and intermittent pain. The tooth was discoloured and when gutta-percha was placed into the sinus tract, it appeared to extend to the tip of the root (Fig. 2a). Probing the area yielded probing depths of 10 mm and beyond across the labial surface. A periapical radiograph showed an irregular periapical radiolucency at the apex of tooth 21, external apical root resorption, short root filling, calcification at the root apex, and a bulk of radiopaque material in the cervical third of the root (Fig. 2b). A laterally placed occlusal radiograph suggested accidental perforation in the buccal aspect of the root canal (Fig. 2c). The case was diagnosed as chronic suppurative apical periodontitis with apicomarginal communication (class IIb lesion) and surgery was scheduled to attempt to correct the defect and to promote healing. The patient consented to the proposed treatment plan after being informed about the methods and risks, and how many radiographs would have to be obtained.

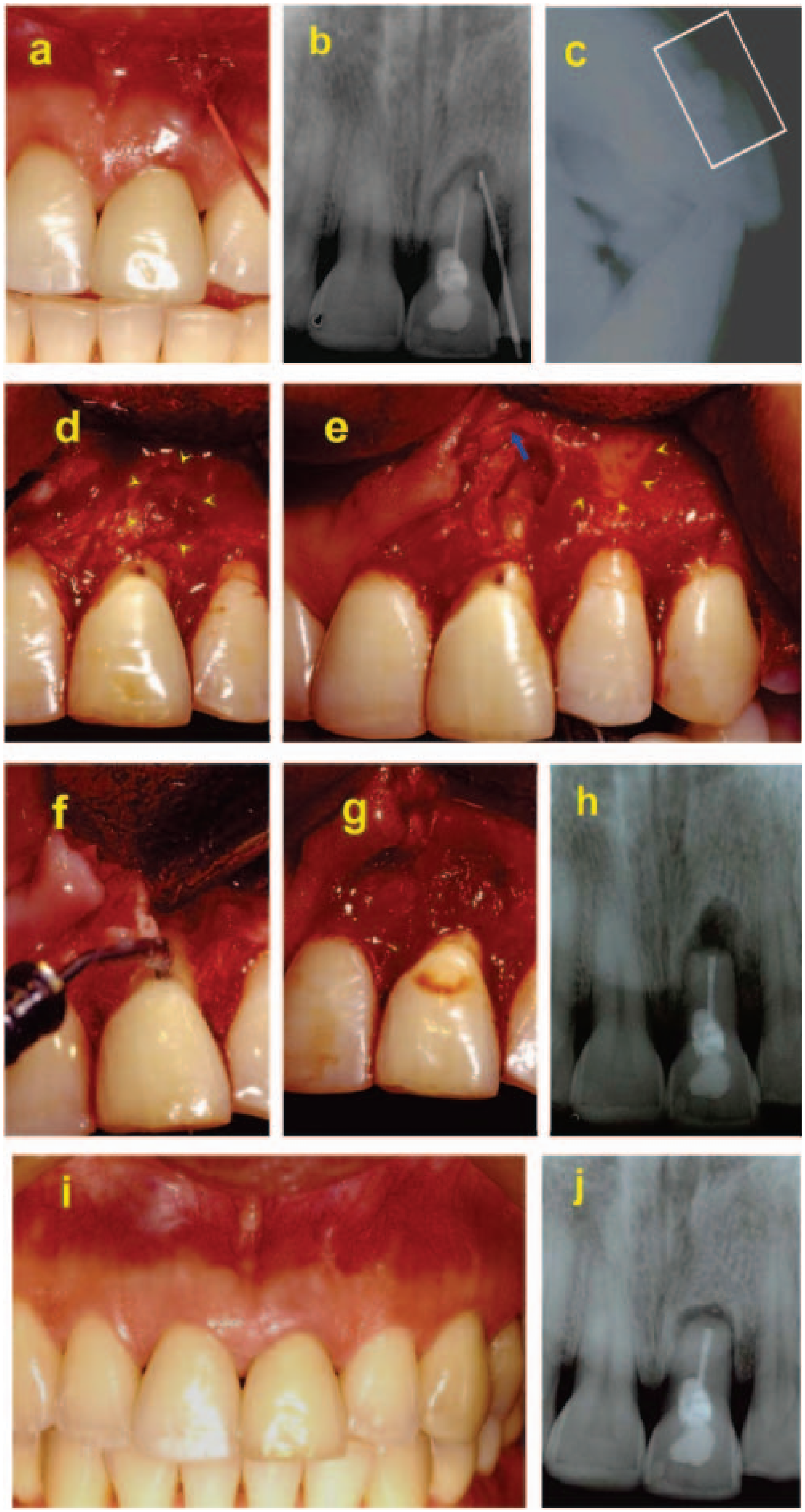
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**Figure 2** Maxillary left central incisor with chronic suppurative apical periodontitis and concomitant marginal lesion with communication (class IIb defect). (a) Clinical presentation before the surgical procedure. Recurring apical drainage through sinus tract opening and periodontal pocket is evident. (b) Preoperative radiograph of periapical lesion. Gutta-percha cone placed into defect extend to tip of root. (c) Laterally placed occlusal radiograph showing accidental perforation in the buccal aspect of the root canal (rectangular zone of interest). (d) Split-thickness flap was executed to reveal the perforation in the cervical third of the root and the granulomatous tissue over the involved tooth (arrowheads). (e) Partial destruction of the buccal cortical plate of bone, total denudation of the buccal surface of the root, and calculus all the way to the root tip are evident after granulomatous tissue has been removed. Incision of the connective tissue around the defect to obtain a graft, which includes periosteum is apparent (arrowheads). An autogenous periosteal graft of appropriate shape and size is raised and stored under the flap (arrow). (f) Ultrasonic instrumentation of the accidental perforation for filling with glass–ionomer cement. (g) The periosteal graft is placed over the entire defect after root-end was filled with IRM. (h) Immediate postoperative radiographical appearance. (i) Clinical appearance at 10-month follow-up visit. (j) Periapical radiograph 10 months after surgery. Significant change in the size and shape of the radiolucent lesion is observed.

### Surgical technique

The treatment protocol was established in accordance with the following general scheme under the control of high resolution surgical binocular loupes (×6.0 magnification) fitted to a fibre optic headlight (Heine Optotechnik, Herrsching, Germany):

1. Preoperative mouth-rinse with a 0.1% hexetidine base mouthwash (Oraldine®; Parke-Davis & Co., Cali, Colombia) for 5 min.
2. Local anaesthesia with lidocaine 2% with epinephrine 1:80 000 (Roxycaine®; Ropshon Therapeutics Ltd, Bogotá, Colombia).
3. A split-thickness flap that consisted of buccal intrasulcular incision including one tooth mesial and two distal to the lesion, and one vertical incision was elevated to fully uncover the buccal surface of the root and access the donor graft tissue site. All incisions were made in a supra-periosteal fashion (Fig. 3a).
4. A Bard-Parker blade was used to incise the gingiva so as to provide an approximately 1.5–2 mm uniformly thick flap wall. The flap was extended under tension as the incision proceeded apically. Care was exercised not to perforate the flap base accidentally with the scalpel (Fig. 3b).
5. After elevation of the flap, the granulomatous tissue over the involved tooth was removed from the bony defect margins by sharp dissection (Figs 1c, 2d and 3c).
6. Connective tissue with periosteum was obtained from the area adjacent to the defect for use as a biological barrier membrane. After four incisions were made: two vertical incisions distal to the defect that connected with a third submarginal horizontal incision, and a small releasing incision in the base of pedicle (Figs 2e and 3c), connective tissue with periosteum was harvested with a periosteal elevator. Sufficient tissue was available in each case and the graft was raised intact and stored under the split-thickness flap until needed (Figs 2e and 3d). Clinically, the graft consisted of connective tissue and included the periosteum confirmed by the fact that the bone surface was left bare.
7. Debridement (periradicular curettage-enucleation) of the bony lesion.
8. Wet planing of the exposed roots with an ENAC® ultrasonic device and ST08 universal tip (Osada Electric Co. Ltd, Los Angeles, CA, USA).
9. Apical root-end resection with cylindrical surgical carbide finishing burs at high speed, with sterile water coolant, removing approximately 3 mm of the root apex. The cut surface was not bevelled.
10. Preparation of a 3-mm deep root-end cavity using an ultrasonic microsurgical system ENAC-OE505S® with DFy-908 double angled diamond files and sterile water coolant (Osada Electric Co. Ltd).

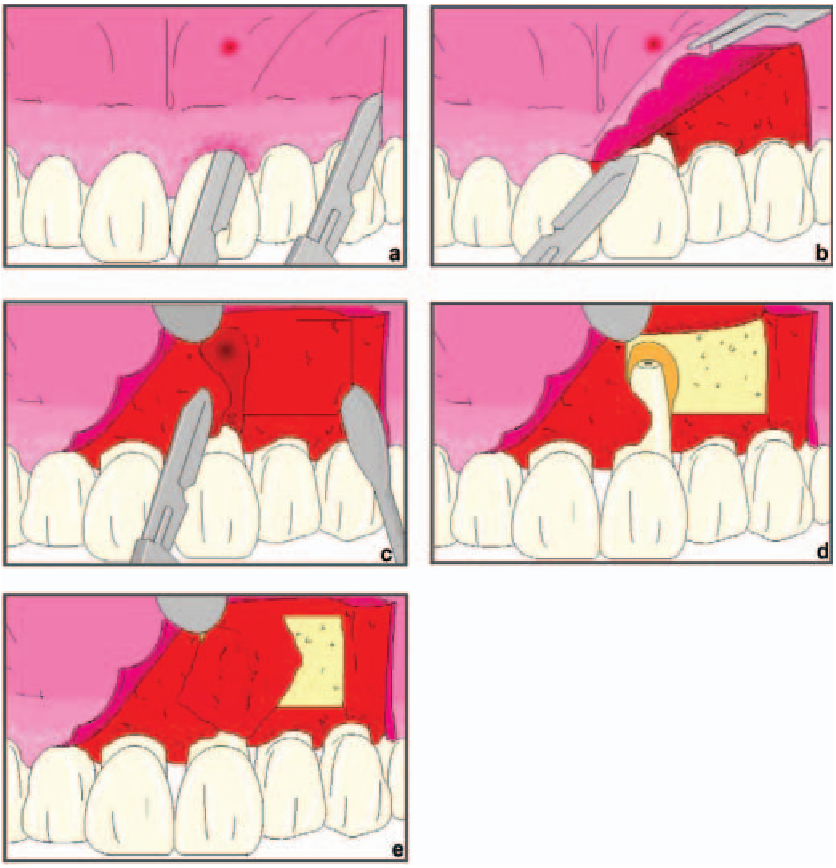


**Figure 3** Illustration shows proposed surgical procedure for an upper central incisor with a class IIb periapical lesion. (a) Flap design and location of supra-periosteal incisions. (b) Split-thickness flap reflected under gentle tension as the sharp dissection proceeded. (c) Periosteal incisions to remove the pathological tissue and to raise the periosteal graft. (d) Surgical exposure of the buccal bony plate and denuded root. (e) Lateral displacement of periosteal graft.

**11.** Root-end filling with IRM® (Caulk-Dentsply, Mildford, DE, USA) using a Messing® syringe (Union Broach; Moyco Ind., Emigsville, PA, USA) and Buchanan pluggers PLGRF1® (Hu-Friedy, Chicago, IL, USA).

**12.** Irrigation with 100 mg $mL^{-1}$ of doxycycline solution for 5 min in order to remove the smear layer, to expose the collagen matrix and to prevent the degradation of collagen (Davis *et al.* 2003).

**13.** Periosteal graft material was positioned to cover the entire defect (Figs 1e, 2g and 3e). The periosteal side of the connective tissue was positioned facing the osseous surface of the defect.

**14.** Wound closure with interrupted Ethicon® 5-0 (Johnson & Johnson, Santafé de Bogotá, Colombia) silk sutures.

**15.** Anti-inflammatory cover with nimesulide (Scaflam®; Schering-Plough, Santafé de Bogotá, Colombia), a selective inhibitor of COX-2 with analgesic and antipyretic properties, 100 mg twice a day for 3 days postoperatively.

**16.** Chlorhexidine mouth-rinse was carried out for 2 weeks postoperatively.

**17.** Sutures were removed at 5 days and then clinical and radiographical controls were performed every 2 months up to 10 months after the operation in order to evaluate the qualitative changes generated in the apicomarginal rarefaction.

 

The management of both cases was carried out essentially as described. The cervical perforation in case 2 was prepared with ultrasonic diamond files (Fig. 2f) and filled with glass–ionomer cement (Vitremer®; 3M Health Care, St Paul, MN, USA). After surgery, pus discharge disappeared. At the 10-month recall examination, the teeth were asymptomatic, with healthy periodontal tissues and normal probing depths. Radiographical examination showed complete bone healing in case 1 (Fig. 1g). The region of periapical radiolucency was substantially reduced but still not healed completely in case 2 (Fig. 2i).

An appropriate follow-up protocol is to perform clinical and radiographical controls every 3 months up to 12 months after surgery and to do critical comparison with the immediate postoperative film. However, in cases of severe bone dehiscence, the likelihood of success is known to be substantially compromised and more close follow-up appointments may be required to detect subtle changes in the mineral content of periapical areas, any increase in the size of radiolucency or no improvement. The patients continue to be monitored at 6-month intervals in order to detect any evidence of signs and/or symptoms of inflammation, tenderness to percussion or palpation, subjective discomfort, mobility, sinus tract formation and periodontal pocket formation. The patients continue to maintain a high standard of oral hygiene and will be kept under long-term review.

## Discussion

Many factors are involved in the healing process of a periapical defect following periradicular surgery. Amongst these, the periosteum is important, as it may act both as a source of osteo-competent cells and as a barrier against the infiltration of epithelial cells, bacteria and bacterial byproducts into the healing site. However, in some defects such as class IIb lesions, especially when a sinus tract is present, the periosteum is often damaged by the infective process (Pecora *et al.* 2001, Von Arx & Cochran 2001).

Lesions of a purely endodontic origin, like the endodontic aspects of combined lesions, have an excellent prognosis (Bergenholtz & Hasselgren 1997) and endodontic treatment alone can result in complete healing in many cases. The occurrence of a periapical pathosis, accompanied by periodontal breakdown, constitutes a multifaceted endodontic–periodontic problem, typically associated with a less favourable prognosis. Furthermore, if the source of the irritation cannot be remove by a nonsurgical endodontic treatment, the treatment must include a combination of endodontic and periodontic interventions. Periradicular surgery corrects the endodontic aspect of the problem while the use of a periosteal sliding graft may address other problems. Based on the results obtained in this report success in a wide range of teeth with apicomarginal lesions may be possible.

From a technical standpoint, crowns with no posts or posts shorter than 5 mm should not be considered as indication for periradicular surgery (Abramovitz *et al.* 2002). In case 1, the surgical procedure was justified by the presence of an amalgam root-end filling along with a post longer than 5 mm; removal of the restoration was considered impractical. However, in case 2, although there were no technical obstructions for endodontic re-treatment, the surgical procedure was indicated by external apical root resorption, in association with apical calcification and cervical perforation (El-Swiah & Walker 1996). Furthermore, intraoperative findings of destruction of the cortical plate, denudation of the buccal surface of the root and presence of amorphous material along the exposed root, justified the surgical alternative.

Pecora *et al.* (1995) demonstrated that the use of the GTR/GBR techniques in humans could enhance the amount and quality of periradicular bone regeneration and these procedures accelerate bone growth in circumscribed defects after periradicular surgery. Dahlin *et al.* (1988) also demonstrated complete healing of bone defects after 6 weeks by using expanded polytetrafluoroethylene (e-PTFE) nonabsorbable membranes for GTR in rats. In a similar manner, Baek & Kim (2001) demonstrated that experimentally induced through-and-through periapical defects in ferrets healed with virtually complete bone fill (95%) after 12 weeks by using vicryl absorbable membranes. Furthermore, the results obtained in this report confirm the findings of Lekovic *et al.* (1991) and Kwan *et al.* (1998) suggesting that autogenous periosteal grafts can be used in GBR and that they may contribute to osseous defect fill.

The clinical and radiographical evidence of newly formed bone does not necessarily indicate regeneration; hence histological evaluation is ideally needed to confirm the efficacy of periosteal grafts in promoting true bone regeneration. It has been stated that lifting of the periosteum or surgical trauma results in a marked generative activity by cells and osteogenesis (Melcher 1971, Melcher & Accursi 1971, Goldman & Smukler 1978). However, in the wound, the cells of the cambium layer of the periosteum are destroyed by the reflective forces used to elevate the flap (Harrison & Jurosky 1991), and the periosteum does not function in bone repair until the osseous excisional wound is almost filled with woven bone trabeculae of endosteal tissue origin (Harrison & Jurosky 1992). This occurs at 14 days post-surgery and suggests that there is an inductive influence from the new bone to the re-forming periosteum to develop osteogenic potential and become a functioning periosteum (Harrison & Jurosky 1992).

In terms of viability, vascularized periosteum is superior to free periosteum. The osteogenic capacity of vascularized periosteum is less affected by the environment of the recipient site as compared with free periosteum (Ishida *et al.* 1996). Special attention was paid to raise vascularized periosteal flaps in both cases, and the results reveal a good osteogenic capacity in the short-term, possibly stimulated by the surgical trauma. According to Ishida *et al.* (1996) vascularized periosteum has the most significant osteogenic capacity at 2 weeks, with a constant level of activity maintained thereafter; it forms new bone soon after the operation, and the amount of bone increases as time passes.

Periosteal grafts can be easily harvested, are relatively abundant, and healing of donor and recipient areas was well tolerated by patients. Another advantage is that the configuration of the periosteum can be adjusted to the shape of the recipient site. The only disadvantages are profuse bleeding during surgery and the moderate degree of difficulty encountered when tissue is split. This last problem can be overcome with practise.

## Conclusion

The results of the present report suggest that the use of periosteal grafts in surgical therapy of combined periapical–periodontal lesions may contribute to a successful clinical outcome.

## Disclaimer

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